GIVING MEANING TO PRODUCTS VIA A CONCEPTUAL DESIGN APPROACH

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ABSTRACT

Although the conceptual design is a fundamental process through which design decisions are made, its focus is on finding the right solution. Is finding the right solution enough for a good design? Defining the problem or applying a solution-focused process may not be enough to create the differences that must be present in today's variable conditions. This can be overcome through seeking meaning instead of seeking a solution. The purpose of this article is to develop an approach that focuses on seeking meaning for products by starting with a design-thinking approach to the conceptual design process in engineering design. Focusing on a search for meaning in engineering design will provide advantages, such as creating unique values and sustainable competition.

Keywords: Conceptual design, Innovation, Creativity

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1 INTRODUCTION

A conceptual design process is a process that requires comprehensive and versatile thinking. 'Conceptual design is considered to be among the most demanding design tasks, as it includes the central transition from a problem to an early solution concept, which necessitates a joint effort of all involved disciplines' (Chakravarthy *et al*., 2001; Erden *et al*., 2008; Eisenbart *et al*., 2014). Many definitions have been offered regarding a conceptual design process, and, likewise, many approaches have been developed. Even though the methods and tools applied may differ, it is the process by which the decisions are made. The conceptual design approach has a direct impact on the product quality.

In solution-focused designs, the designer prepares a solution proposal and uses it to help develop an understanding of 'what the problem is and what appropriate solutions' may be (Cross, 2000). The process is based on producing solutions; however, often too little time is spent on identifying the problem for the obtained solution (Kruger *et al*, 2006). Indeed, Cross (2006) suggests that all problems should be defined as being ill-defined; this is because frequently ill-structured problems can have various alternative solutions that cannot be compared with each other (Dorst *et al*., 2006). In general, the conceptual design process is a searching process. What is the value to be achieved as a result of this search process? A solution-focused process in engineering design can be useful in terms of time and creativity. However, the approach to be applied in a conceptual design process should result in different qualifications in terms of the product; for example, the company should have a competitive edge. Moreover, in addition to a product's characteristics, such as function and form, a product must also overcome open, dynamic, complex and networked design challenges (Dorst, 2015). A solution-focused process in engineering design may not be enough to compete with a product that can be created in the future. Today, a design should contain much more than function and form. This can be achieved by 'the shift from the search for solutions to the search for meaning' (Verganti, 2016). According to Levy (1959), 'people buy products not only for what they can do, but also for what they mean' (Verganti, 2009). Verganti (2016) explains the innovation of meaning as follows:

'Creating meaningful products, like making gifts, is an act of responsibility and pleasure. Responsibility because, through the gift, we have a chance to create a more meaningful world. It's the way we contribute to people's life. Pleasure because when we love the gift, we pleasure ourselves in making it. So the gift is for the receiver, but the act of making the gift is for us. When this happens, we create meaning. People will smell it even before seeing it. And they fall in love.'

Beginning a design with a search for meaning in the conceptual design process will give the designer a feeling of perfect freedom and a sense of fulfillment in his or her designs. As Lasdun (1965) states, 'Our job is to give the client… not what he wants, but what he never dreamed he wanted; and when he gets it, he recognizes it as something he wanted all the time' (Cross, 2000). Likewise, Steve Wozniak defines the meaning of a product: 'People will never love a product you do not love. If you do not love it yourself, they feel it… they smell it' (Verganti, 2016). If the goal is to design a product that a customer can love, the process should be exciting and pleasurable for the designer. Such a challenge will be met by answering the question: 'How is the meaning of a product created during the conceptual design process?'

2 DESIGN THINKING

2.1 Reasoning with convergent and divergent thinking

Although approaches to the engineering design process differ, the proposed methods are based on logical inference. Jones (1963) put forward a problem-focused model, which can be executed by deductive and inductive reasoning, that includes analysis, synthesis, and evaluation stages (Wynn *et al*., 2005). As in Jones' process model, in traditional methods, abduction is a logical inference, which relies on the awareness of the designer. Abduction is a mode of reasoning in situations where data and information are limited and uncertain (Mounarath *et al*., 2011). March proposed a solution-oriented design process model which includes the following stages: production (abduction), deduction, and induction (Wynn *et al*., 2005). Thus, he emphasised logical reasoning in the design process.

The similarity in engineering designs developed with logical inferences shows the inadequacy of logical inference in abduction in practice. As Dorst (2015) notes, 'If we want to create valuable new

"things", as in design and the other productive professions, the basic pattern of reasoning is called "abduction"'. As suggested by VDI (Verein Deutscher Ingenieure, (West) German Association of Engineers) guideline 2221, traditional engineering design methods lead to the creation of a function structure with deduction and induction to achieve a solution to the problem. Finding the right solution to an ill-defined problem creates a new problem without solving the existing one. Could the misidentification of a problem stem from the inadequacy of the applied method? The key to moving forward with good and informed solutions is to know how to converge them (Ling, 2015). In the Double Diamond design model proposed by the Design Council (2015), the logical process is evaluated through knowledge of divergent and convergent thinking approaches. The Double Diamond model provides the appropriate thinking methods for reasoning in the design process.

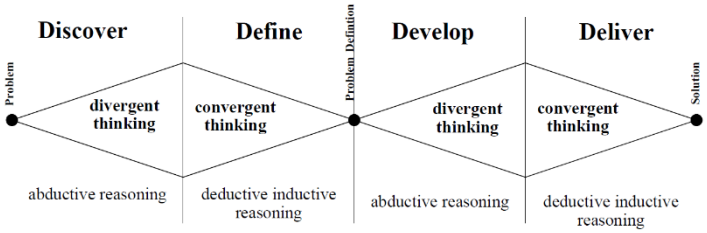

Figure 1. Double diamond model

As shown in Figure 1, in the discover and develop stages with a divergent thinking approach, abductive reasoning is done. In the define and develop stages with a convergent thinking approach, which gets closer to the best result in all creative processes, deductive and inductive reasoning are done.

2.2 Design thinking in outside-in and inside-out approaches

Pablo Picasso observed, 'All children are artists. The problem is how to remain an artist once he grows up'.

Regardless of which field the design process is applied to, does not the artistic content have to be considered? Can design be defined as products that carry artistic value as well? How can engineering design incorporate artistic value? Is it necessary for an engineering design to have an artistic bent? Brown (2008) emphasises the 'think like a child' concept for design thinking and explains that 'we need trust to play, and we need trust to be creative'. Could the trust needed to play be what adds artistic value to engineering design? At the heart of design thinking is abductive logic (Martin, 2009a). As Martin (2009b) points out, 'Design thinkers want their ideas to make a difference in the world'. Can this difference be explained as adding value to design? For designers, this desire to make a difference can be realised by making a thinking art design. They can accomplish this by seeking creative solutions through different perspectives. Design creativity is a key driver for innovation (Milojevic *et al*., 2016).

Figure 2. Alessi's anna g.

By launching Anna G. (shown in Figure 2) in 1991, Alessi made a great difference in the world, doubling its sales in the first three years while the sales of its rivals were stable (Verganti, 2016).

In addition to commercial success, Anna G. has been an inspiration for the production of objects inspired by emotional design. Anna G. presents warmth to people and perhaps the confidence that they felt in their childhood. Like the touch of an artwork to the soul of a human being, the use of an Anna G. corkscrew in daily life has responded to the happiness and desire of people, which is a feeling that a

normal corkscrew cannot give to them. The search for creative solutions for Anna G. still continues with the innovation of meaning.
Stanford University d.school has developed a human-focused five-stage design process model which is effective in finding new and innovative solutions. As shown in Figure 3, the first stage of the process is 'empathise', which forms the basis of the human-focused design process. Next, the define stage involves creating a design vision, which has critical importance because problem definition is done in this stage. The production of ideas takes place during the ideate stage. In the prototype stage, it is effective to consider what to test and what kind of results to look for. The final stage is the chance to improve the solution. At the same time, this phase also confirms that the question is framed properly (IDEO, 2015).

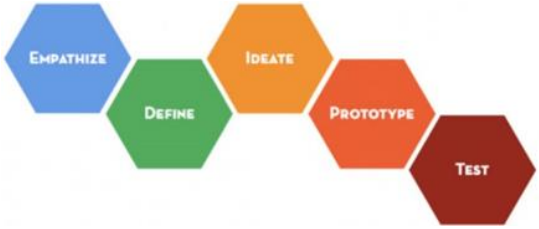

Figure 3. d.school design thinking process

It is considered that good designs, with the outside-in approach, are built on a robust understanding of people's beliefs and values. However, while the outside-in approach is good for finding creative solutions, people search for meaning (Verganti, 2016). The innovation of meaning proposed by Verganti (2016) is applied through the inside-out approach. Thanks to this approach, people can find their beliefs and values in the product as well as the product's functional benefits. In addition, the inside-out approach can encourage and liberate design thinkers to build the 'trust needed to play'.

3 PROPOSED NEW APPROACH

Managing to touch people's hearts with engineering design is not often preferred for competitive advantage. With the proposed approach, engineering products can be designed in which product performance is developed according to the product meaning created. Thus, engineering designs can compete in different directions with the different interpretations they contain and provide superiority with the right application. As shown in Figure 4, the design process is modelled with a leaf. The meaning of the leaf for living things is life. Engineering products which are designed with the model inspired by this meaning will include useful meanings and be innovated by the innovation of meaning. The formation of a leaf on a branch occurs with the formation of the previous leaf or leaves. Thus, in order to achieve a product definition with a ten-step, meaning-focused conceptual design method, each stage must be completed in order.

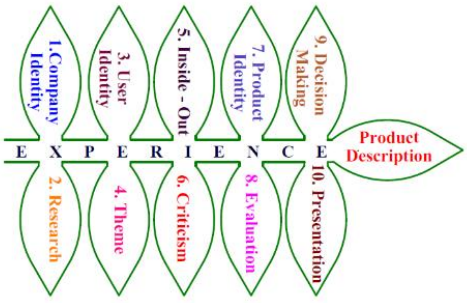

Figure 4. Meaning – focused design model

In the leaf model, there are stages that can be applied for the meaning innovation, proposed by Verganti (2016) and identification of the product's meaning, suggested by Gotzsch (2002).
In the meaning-focused conceptual design method, it is necessary to think critically to reflect the meaning. Critical thinking is a search for answers, a quest (Ruggiero, 2012). The searching question which will be answered in the proposed method is, 'What would I love people to love?' (Verganti, 2016). Kallet (2014) defines three stages in critical thinking: clarity, conclusions, and decisions. In the leaf model, the first four stages form the clarity process, the conclusions stage is the creation of

hypotheses, and the decisions stage is the meaning that will be achieved during the discussion in the criticism phase. Other choices to create the product must be selected accordingly, to reflect the meaning. To increase applicability and efficiency, the method has been proposed for some specific cases. These are:

- decrease in product sales, criticism from customers, etc.;
- increased product alternatives, technological changes etc.;
- uncertainty about its inclusion in the product range of the company and lack of demand etc.;

Regarding the method, a particular sector or a specific product can be considered. As it is understood from the stated cases, the method includes strategic orientation focused on meaning innovation, which can be applied to existing engineering designs.

3.1 Company identity

At this stage, the firm should determine its beliefs and aims. What did the company believe when it commenced the design process for this product; what was its purpose? This is a belief that the customer will decide, because 'people don't buy what you do; people buy why you do it' (Sinek, 2009). To be able to establish belief in the project, they should be able to answer: 'Why?' This stage is similar to the answer to the question that Roger and Lafley (2013) proposed to win as the first stage of the strategy-making process: 'What is your winning aspiration?' How should a firm create a desire to win in a design project? Golden Circle, recommended by Sinek (2009), is effective in determining this belief with a direction from the inside out. From the outside-in approach explains, respectively, what they do and how they do, can enable the firm to take part in the competition. However, with an inside-out approach, the company will be able to determine the reason, that will make it a leader, like Apple:

> *Everything we do, we believe in challenging the status quo. We believe in thinking differently. The way we challenge the status quo is by making our products beautifully designed, simple to use and user-friendly. We just happen to make great computers. Want to buy one?*

3.2 Research

Prior to this phase, the reason and purpose for the project are determined. In order for the firm to reach its goal, it should make choices that will narrow the competition area. It plans in which countries and regions to compete. In this way, the firm can determine both its competitors and its target customers. The determination of the competition area enables the collection of data necessary for the following sections by examining the existing products. The required investigations are carried out in order to eliminate deficiencies in the product that are not noticed by the customer. In other words, customer behaviour and customer decision-making processes can be considered. Within the determined competition area, the factors underlying customer needs and motivations are investigated.

3.3 User identity

The identification of the user's identity will increase the appeal of the product to the user. Gotzsch (2002) defines user identity in two stages as personal characteristics (gender, age, and personality) and social characteristics (status and success, ambitions, values, and lifestyle). Benefits that can increase product and user compliance should be determined. Identifying the user is a facilitator in the decision of product identity. For instance, we know that a person does not buy the same gift for her mother and her friend.

3.4 Theme

'Themes are a tool, a form of capturing the underlying phenomenon in a situation one is trying to understand.' (Dorst, 2015). Therefore, the most important effect of determining the theme on meaning formation is that it indicates the area that designers need to interpret in the inside-out stage. The work done up to this stage includes the concepts that can form the theme. The theme acts as a bridge between the human (cultural) area and the technical, economic areas (Dorst, 2015). Versatile themes can be created with creative thinking.

3.5 Inside-out

At this stage, which is the conclusions stage according to Kallet (2014), the studies are interpreted according to the insights of the designer and the conclusions are formed by hypotheses. The designer must create solutions that he or she can love within certain boundaries; themes and aims (inside out: why, how, what) create such limits. Solutions are mentioned because the themes include anything lacking in the current situation (product, service, etc.); for this reason, the meaning can be taken to include solutions. The designer should be able to critically approach his or her own interpretation. He or she should evaluate the hypothesis in terms of conformity with the purpose and themes, which means that the hypothesis should be convincing and logical at the next stage. The number of hypotheses created may vary according to the number of members in the design team. Each designer can create many hypotheses, but this can lead to confusion at the next stage. Verganti (2016) suggests that, in a design team of 15 to 20 members, each person should ideally create a sound hypothesis. 'Essential to the success of multidisciplinary team working is that the members all share a common purpose that takes precedence over their individual agendas' (Bailey *et al*., 2016).

3.6 Criticism

Although most people react against criticism, it develops hypotheses. In other words, if a criticism is given objectively to strengthen weaknesses, the result is not based on an individual hypothesis and a new meaning has been established. The criticism phase for deciding the meaning is explained in four sections.

1. The hypotheses are presented and those with similar features are matched. Thus, pairs consisting of challengers and defenders are determined for discussing the hypotheses.
2. The pairs capture the potential and weakness behind their hypotheses and form a new hypothesis by questioning the differences in each others. The aim of this questioning is to provide a more in-depth, joint hypothesis covering their interpretations (Verganti, 2016). Pairs should be critical, not supportive or passive: tension is a valuable resource (Verganti, 2016). A major challenge is to maintain the creative confidence of individuals (Kelley & Kelley, 2013) while critiquing their work.
3. The created hypotheses matching the number of pairs are shared with the designers involved. This presents new tension, because the different aspects of the hypotheses are compared and questioned. Features in the hypotheses that cause differences are determined. Designers should focus on a few options that can make a difference to customers.
4. Two hypotheses which point in different directions contain strong and weak interpretations of the theme. By combining hypotheses that complement each other, meaning is created.

3.7 Product identity

The product identity should be able to reflect the intended meaning when evaluated as a whole. To reflect the meaning correctly, product benefits are examined in three groups: place in time and culture, effective signs, and product information. Trying to transfer all of these features to a product will mean that it does not appeal to anyone. The user characteristics can be effective in helping to select the product benefits. Product identity groups include place in time and culture, which recommends researching values that may be inspired by culture and history or combining different cultures. Knowing the competition area and user identity can be a guide in the determination of cultural values and beliefs. Historical features often remind us of past events; however, in the scope of the method, this is defined as adapting the artworks of the past to today's technology. Furthermore, the designer can add futuristic interpretations to past engineering products; for example, the water wheel filter.
Styling movements can be defined as designer touches. This can be considered a combination of two different cultures if the product is to be sold in a region different from the designer's culture. Transferring it to an engineering design can challenge the limits of creativity. On the other hand, another benefit of the method is forcing designers to move away from prejudices. There are designs inspired by different cultures in fashion and architecture. By transferring this to engineering design, styling movements can be realised. The only route to healthy growth is creating a remarkable product (Godin, 2002).

Another identity group is effective signs. Emotions can be reflected in many different ways. Some of these include nature symbols, artistic feel, and human characteristics. Nature symbols have always been a source of inspiration for designers. Artistic feel is unfortunately felt rarely in engineering products. Nonetheless, design movements such as art nouveau and art deco can also be realised in engineering designs. The important thing is to decide that you want to be more creative (Kelley & Kelley, 2013). Unlike in the user identity stage, human characteristics and emotions are emphasised in this stage. Gotzsch (2002) examines human characteristics in two stages as emotions and human form. There are countless ways of conveying emotions: one could think of street wall-art as an inspiration for engineering designs. An anthropomorphic form can be effective in establishing friendly relations with the user (Gotzsch, 2000; Marzano, 2000).

The fact that a specific product is not specified for the method may cause engineering designers to doubt whether they should apply the method due to functional differences in the products; however, the function structure will be developed according to the intended meaning. Creating a product function structure in a meaning-focused approach, or improving its current function, is just one of the values that make up the product's identity. Another identity group is the defining phase of product information. This is the stage in which changes to be made in the working principle of the product will be realised. Functional developments which will add functional superiority to the product in the market are created in this phase. There are many recommendations for function analysis, but our suggestion is the reverse engineering method, because thereby questioning and evaluation can be carried out more efficiently.

3.8 Evaluation

It is possible to reflect meanings in different ways. The options for reflecting a meaning correctly were presented in the previous section; the identification of compatible combinations of these options and evaluation through prototyping is carried out at this stage. The reason for prototyping is to carry out questioning effectively because the act of creation forces one to ask questions and make choices (Kelley & Kelley, 2013). In the prototype evaluation form shown in the Figure 5, the product identity that makes up the combination is explained in the relevant sections by picture or text.

MEANING	IDENTITY / CONSTRAINTS				Product Gestalt	Functionality	Usability	Producibility	Availability	Maintainability	Sustainability	Safety	Reliability	Quality	Added Value	Return on Investment
COMBINATION	1.Place in Time&Culture	Culture			Which of these benefits are visually reflected in the intended meaning? Which of these are combined? And why?	When the product performs its function, is the integrity of the visual values and meaning preserved?	Do the product values obtained by the constraints, which are Product Gestalt and Functionality, address the user identity? Does the user find it easy to use?	Can the specified visual values be produced? Which production method is suitable? Can production be carried out using existing facilities?	Where will the product be introduced to the customer? From where can the customer buy the product? In which way it will be transported?	Can product maintenance be done by the user? Given product benefits, can it be easily maintained? Should maintenance service or training be provided to customers?	Can the product be recycled?	Have appropriate precautions been taken to protect the user from danger? Are there any situations that may be dangerous to the user? Are the choices, which are materials, paints etc., suitable for health?	Will the product create trust in the user? If the product produces waste is there a solution to recycle the waste? Do any measures reduce damage to the environment? Does the product fulfil the needs of the user? Does the product communicate its meaning effectively?	What is the estimated product life as a result of the correct use of the product? Will the selected material be sufficient to maintain integrity throughout the product life?	What is the sales price for selling in the specified area? Does it exceed the customer's purchasing power?	What is the target profit?
		Historical														
		Styling Movements														
	2.Effective Signs	Human Characteristics	Emotion													
			Shape													
		Nature Symbols														
		Artistic Feel														
	3. Product Information	Working Principle		PROTOTYPING	Does the selected material reflect the visual values?	What innovations will be made to its functional benefits? Why? Will functional innovations be a surprise to customers? How superior are the new functional benefits compared to existing products? How do meaning and function relate?		How should the connections between the parts of the product be made? Is it suitable for assembly and disassembly?			Does the product save energy during operation? Can the function be fulfilled with renewable energy sources?					
		Novelty & Surprise														
					EVALUATION											

Figure 5. Prototype evaluation form

The prototype and form should be prepared for the number of combinations created in order to test the specified product options. Constraints are necessary for evaluating the choices that make up the product identity and to give new qualities to the product. For this purpose, the product attributes that are defined by integrated design engineering (IDE) will be restrictive in the questioning and evaluation.

These attributes are product gestalt, functionality, usability, producibility, availability, maintainability, sustainability, safety, reliability, quality, added value, and return on investment (Urakami & Vajna, 2018). Some questions have been recommended in the form to assess the compatibility of constraints and product benefits. Strong prototypes that take the most valid answers from the questions and are

considered successful in reflecting the meaning should be prepared in such a way that they can be presented to the customers and users.

3.9 Decision making

The selection of the prototype for the embodiment design will be decided by all stakeholders, including customers and end users. In order to achieve this, it is important to have good communication with stakeholders. Moreover, involving stakeholders with decision making can create a good impression of the firm's attitude. There can be many different ways to present powerful prototypes for customer evaluation. Focus groups, online surveys, user trials with prototypes etc., are all suitable methods employed at this stage.

3.10 Presentation

The prototype which is the most loved will be announced to stakeholders. The company can determine the method of announcement according to its own preferences.

4 CONCLUSION

'Most of our so-called reasoning consists in finding arguments for going on believing as we already do' (Robinson, 1945; Ruggiero, 2012). In the proposed method, approaching the conceptual design process with critical thinking increases creativity and go beyond what has been believed before. A great majority choose to be amazed by what they see in a magic show; it is necessary to think critically to find the truth under the perceived situation. With divergent and convergent thinking, there may be differences between the perceived situation and reality. Critical thinking will ensure that the reason behind each step is known. The most important factor that will bring great successes is to know the reason for each step during the design process. Starting with the outside-in approach by observing the design process advances the process over a single direction or in a wrong direction. In order to be able to make a correct observation, there is a need to interpret what is seen. In other words, it demands the ability to think critically. In the proposed method, the designer will form his own hypotheses with the inside-out approach. In this way, a design engineer can think freely, criticise her own hypothesis to defend what she loves, and strengthen the hypothesis with her own knowledge and experience. With the decision of meaning, there is a new reason that will form the basis of the next stages. How and what to do is their result. The creation of product benefits, inspired by culture, art and nature, creates the time to apply the art of connection. Another step that will increase creativity in product design is to create a prototype. The evaluation of the prototype by questioning will enable the discovery of weaknesses and the formation of differences. Making a decision between strong prototypes with customers and users will make the customers feel special. The presentation of the selected prototype through an integrative organisation such as a meeting would be exciting and interesting. Without the production of prototypes, the introduction of the product may face the concern that similar products are produced by other firms. However, meanings are interpretations, the interpretation of each designer is different, and products designed with the meaning-focused design process cannot be imitated. They are just a source of inspiration. Thanks to the design achieved as a result of the correct implementation of the process, the fatigue created by criticism will be replaced by self-confidence and durability.

REFERENCES

Bailey, M., Spencer, N., Bentham, A., Baylis, B. and Sams, P. (2016), "What on Earth is Responsible Innovation anyway? (And how to make it happen)", In: *The 18th International Conference on Engineering and Product Design Education*, 8th - 9th September 2016, Aalborg.

Brown, T. (2008),*Tales of Creativity and Play*.[online] *Ted Talks*. Available at: https://www.ted.com/talks/tim_brown_on_creativity_and_play/transcript#t-1232573 (Accessed 22.11.2018).

Chakravarthy, B. K., Albers, A. and Schweinberger, D. (2001), "Collaborative environment for concept generation in new products", [online] *Proceedings of International Council of Societies of Industrial Design (ICSID 2001)*. Available at: https://www.researchgate.net/publication/36452884 (Accessed 22.11.2018).

Cialdini, R.B. (2001), *Influence: science and practice*, Allyn & Bacon, Boston.

Cross, N. (2000), *Engineering design methods strategies for product design*, John Wiley & Sons Ltd, UK.
Cross N. (2006), *Designerly ways of knowing*, Springer-Verlag London Limited, Germany. https://doi.org/10.1007/1-84628-301-9
Design Council, (2015), "The Design Process: What is the Double Diamond?", [online] *The Design Council*. Available at: https://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond (Accessed 21.11.2018)
Dorst, K. (2015), *Frame innovation: create new thinking by design*, MIT Press, United States of America.
Dorst, K. and Cross, N. (2001), "Creativity in the design process: co-evolution of problem-solution", *Design Studies*, Vol. 22 No. 5, pp. 425–437. https://doi.org/10.1016/s0142-694x(01)00009-6.
Dorst, K. and Royakkers, L., (2006), "The design analogy: a model for moral problem solving", *Design Studies*, Vol. 27 No. 6, pp. 633–656. http://dx.doi.org/10.1016/j.destud.2006.05.002.
Eisenbart B., Gericke K. and Blessing L. (2014), "Application of the IFM Framework for Modelling and Analysing System Functionality", *International Design Conference DESIGN 2014*, Dubrovnik, Croatia, May 19-22, 2014, pp. 153–162.
Erden, M., Komoto, H., van Beek, T. J., D'Amelio, V., Echavarria, E. and Tomiyama, T. (2008), "A review of function modeling, approaches and applications", *AI EDAM*, Vol. 22 No. 2, pp. 147–169. https://doi.org/10.1017/s0890060408000103.
Godin, S. (2002), *Purple cow: transform your business by being remarkable*, Penguin Publishing Group, New York.
Gotzsch, J. (2002), *Product charisma*, [online] HAL, Grenoble Ecole de Management. Available at: https://www.researchgate.net/publication/46477401 (22.11.2018).
IDEO, (2015), *The Field Guide to Human-Centered Design*, IDEO.org, Canada. Available at: http://bestgraz.org/wp-content/uploads/2015/09/Field-Guide-to-Human-Centered-Design_IDEOorg.pdf (Accessed date 23.11.2018).
Jones, J. C. (1963), "A method of systematic design", In: *Conference on design methods*, Pergamon Press, London.
Kallet, M. (2014), *Think smarter: critical thinking to improve problem-solving and decision-making skills*, John Wiley & Sons, Inc., New Jersey.
Kelley, T. and Kelley, D. (2013), *Creative confidence: unleashing the creative potential within us all*, Crown Business, United States.
Kruger C. and Cross N. (2006), "Solution driven versus problem driven design: strategies and outcomes", *Design Studies*, Vol. 27 No. 5, pp. 527–548. http://dx.doi.org/10.1016/j.destud.2006.01.001.
Lasdun, D. (1965), "An architect's approach to architecture", *RIBA Journal*, Vol. 72 No. 4.
Levy S. J. (1959), "Symbols for sale", *Harvard Business Review*, Vol. 37.
Ling, D. (2015), *Complete design thinking guide for successful professionals*, Emerge Creatives Group LLP, Singapore.
Martin, R. (2009a), *The opposable mind: how successful leaders win through integrative thinking*, Harvard Business School Press, Boston.
Martin, R. (2009b), *The design of business: why design thinking is the next competitive advantage*, Harvard Business Press, Boston.
Martin, R. and Lafley, A. G. (2013), *Playing to win: how strategy really works*, Harvard Business Review Press, Boston.
Milojevic, H., Girardello, A., Zhang, Z. and Jin, Y. (2016), "Influence of thinking style on design creativity", *The Fourth International Conference on Design Creativity (4th ICDC)*, Atlanta, GA, November 2-4, pp. 1–8.
Mounarath, R., Lovallo, D. and Dong, A. (2011), "Choosing innovation: how reasoning affects decision errors" *International Conference on Engineering Design (ICED11)*, Technical University of Denmark, 15–18 August.
Robinson, J. H. (1945), "The practical cogitator, or the thinker's anthology", In: Curtis Jr., C. P., Greenslet, F. (Ed.), Houghton Mifflin, Boston, p. 6.
Ruggiero, V. R. (2012), *Beyond feelings: a guide to critical thinking*, McGraw-Hill, New York.
Sinek, S. (2009). *Start with Why? How great leaders inspire everyone to take action*, Portfolio Penguin Group, United States of America.
Urakami, J. and Vajna, S. (2018), "Human Centricity in Integrated Design Engineering", *International Design Conference DESIGN 2018*, Dubrovnik, Croatia, May 21- 24, 2018, pp. 679–690. https://doi.org/10.21278/idc.2018.0154.
VDI 2221 (1987), *Systematic approach to the design of technical systems and products*, VDI, Düsseldorf.
Verganti, R. (2009), *Design-driven innovation: changing the rules of competition by radically innovating what things mean*, Harvard Business Press, Boston.
Verganti, R. (2016), *Overcrowded: designing meaningful products in a world awash with ideas*, The MIT Press, United States of America.
Wynn, D. and Clarkson, J. (2005), "Models of designing", In: Clarkson, J., Eckert, C. (Ed.), *Design process improvement: a review of current practice*, Springer-Verlag London Limited, United States of America, pp. 35–59.